

FINGERTIP TACTILE-SENSE INPUT DEVICE AND PERSONAL DIGITAL ASSISTANT USING IT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of international application PCT/JP02/08395, with international filing date of Aug. 20, 2002.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to fingertip touch input devices for entering alphanumeric data into Personal Digital Assistants (PDAs), cellular phones, and other information terminals and electronic equipment, especially handheld ones.

[0004] 2. Background Art

[0005] In recent years, Personal Digital Assistants (PDA), cellular phones, and Personal Handy Phone Systems (PHS) have become popular. Such devices are miniaturized for convenient carrying. Various models are available. Some can receive and transfer image data, and some include a camera to obtain the image data.

[0006] NTT DoCoMo, Inc. of Japan is providing an Internet access service called i-mode that is used in Japan and some European countries. This service connects a cellular phone to the Internet. In order to connect a cellular phone to the Internet, the display screen on the cellular phone is made as large as possible, and more legible display screens came to be desired.

[0007] However, if a PDA uses the structure of a conventional key button array, there is a limit to the size of the display. This is because the key buttons in such an array are close to each other. Therefore, when a user pushes a key button with a finger, an adjoining key button may be pushed accidentally. To avoid simultaneously depressing two adjoining key buttons, the pitch of key buttons must generally be 8 mm-15 mm. This causes keypads to be about 40 mm-50 mm wide and 50 mm-60 mm long, including a function key. A display screen on the same surface of a PDA as the keypad must be made smaller if the keypad is larger. Otherwise, the PDA must be made larger, making it inconvenient to carry.

[0008] Japanese patent JP,2000-165492 shows conventional key button structures for cellular phones. FIG. 11 herein shows such a prior art structure. A depression 101 is formed in the outer case 100 of a cellular phone. It receives a key button 102 having a backward projection 103. A dome 105 in a resilient sheet 104 gives a tactile click when the button is pressed. An electrically conducting foil 106 is printed on the dome 105. A conducting pattern 108 is formed in a substrate 107. A cushion 109 is provided in the depression 101. A lower case layer 111 is provided.

[0009] A hole 110 in the bottom of depression 101 receives the button projection 103. The dome 105 of sheet 104 is located under the button projection 103. When a button 102 is pressed, the user feels a click due to the resiliency of the dome. The printed wiring 106 on the underside of the dome contacts the pattern 108 of substrate 107. The key buttons 102 are sealed against the outer case

100 to prevent water or foreign matter from penetrating and damaging the internal electric parts.

[0010] A fingertip covers one key button 102, and only the surface area that can be pushed selectively, is required for a keypad. It is necessary to provide spacing between the key buttons of about 0.5-1.0 times the size of a key button so that two or more key buttons 102 are not pushed simultaneously. For this reason, if the size of each key button 102 is about 10 mm×10 mm, and the keypad array has a 3×8 array of buttons, the width of the keypad array is 50 mm-70 mm and the length is 105 mm-170 mm. The smallest possible keypad is about 50 mm wide and 80 mm long. This keypad limits the size of display screen that can be used. This is a serious limitation for a cellular phone or PHS, which can transmit and receive pictures and animations.

[0011] Japanese patent JP,2000-278391 shows a cellular phone with a handwriting input pad on the back of the case. FIGS. 12A, 12B, and 13 herein show such a prior art device. FIG. 12A is a back perspective view of a conventional cellular phone with a handwriting pad on the back. FIG. 12B is a front perspective view of the cellular phone of FIG. 12A. FIG. 13 is a block diagram of a conventional cellular phone that performs handwriting input on a pad on the back. In FIGS. 12A and 12B a touch panel 120 is mounted on the back side of a cellular phone. An LCD display 121 on the front of the cellular phone performs the various displays of a cellular phone. Key buttons 122 on the front of the phone are operated by a hand 123. FIG. 13 shows that the touch sensitive panel 120 is operated by a touch-panel drive means 120a, and the LCD display is operated by an LCD actuation drive 121a. Operation drive means 122a senses depression a key button 122 as an input signal.

[0012] The touch panel 120 can input handwritten lines and alphanumeric characters. Since this conventional cellular phone has a touch panel 120 on the back, it requires fewer front key buttons 122. This allows a larger LCD display 121. However, the operation of handwriting input is complicated, and it cannot create E-mail quickly. It is difficult to increase the precision of character recognition. A user inputs data while looking at the touch panel 120 on the back. The user must turn the phone over and view the front LCD display in order to verify input. This is user-unfriendly. The front key buttons 122 are fundamentally the same as the key buttons on a conventional Personal Digital Assistant.

[0013] As explained above, a conventional key button array on a Personal Digital Assistant requires key buttons large enough to allow a fingertip to push only one button at a time. For this reason conventional keypads including function keys are normally about 50 mm-70 mm wide and 105 mm-170 mm long. Even the smallest of these keypads is a problem for PDAs, cellular phones, and other handheld digital devices that display images and animations, because the keypad restricts the display screen size.

[0014] A conventional handwriting pad on the back of handheld digital devices can reduce the number of front key buttons, allowing a larger display screen on the front. However this has disadvantages as mentioned above. A better approach is needed to miniaturize a PDA while making the display as large as possible.

SUMMARY OF THE INVENTION

[0015] The object of the invention is provision of a smaller type of fingertip tactile-sense input device for entering